

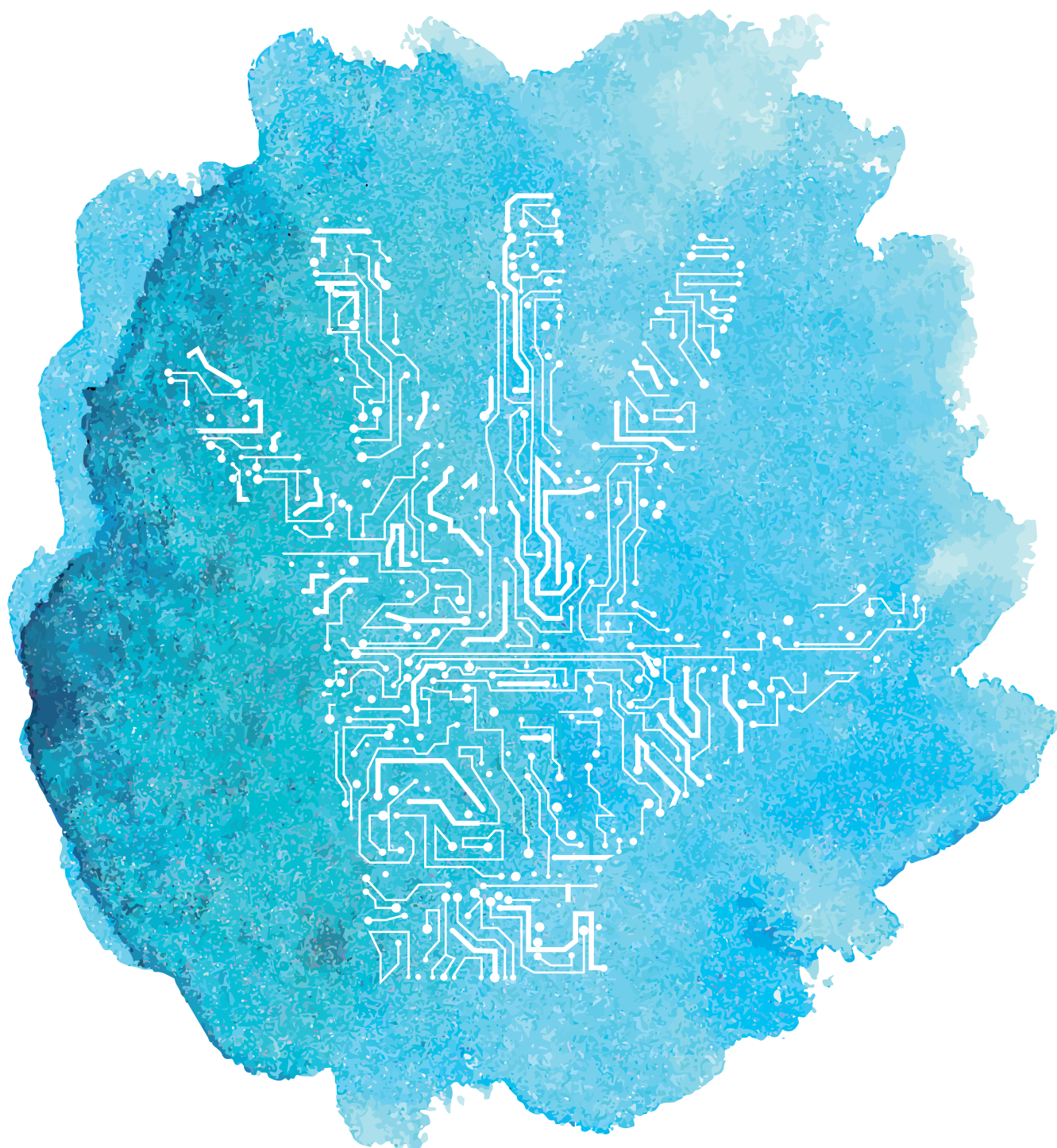


UNITED NATIONS  
INDUSTRIAL DEVELOPMENT ORGANIZATION

# Accelerating clean energy through Industry 4.0

Manufacturing the next revolution

## Executive Summary



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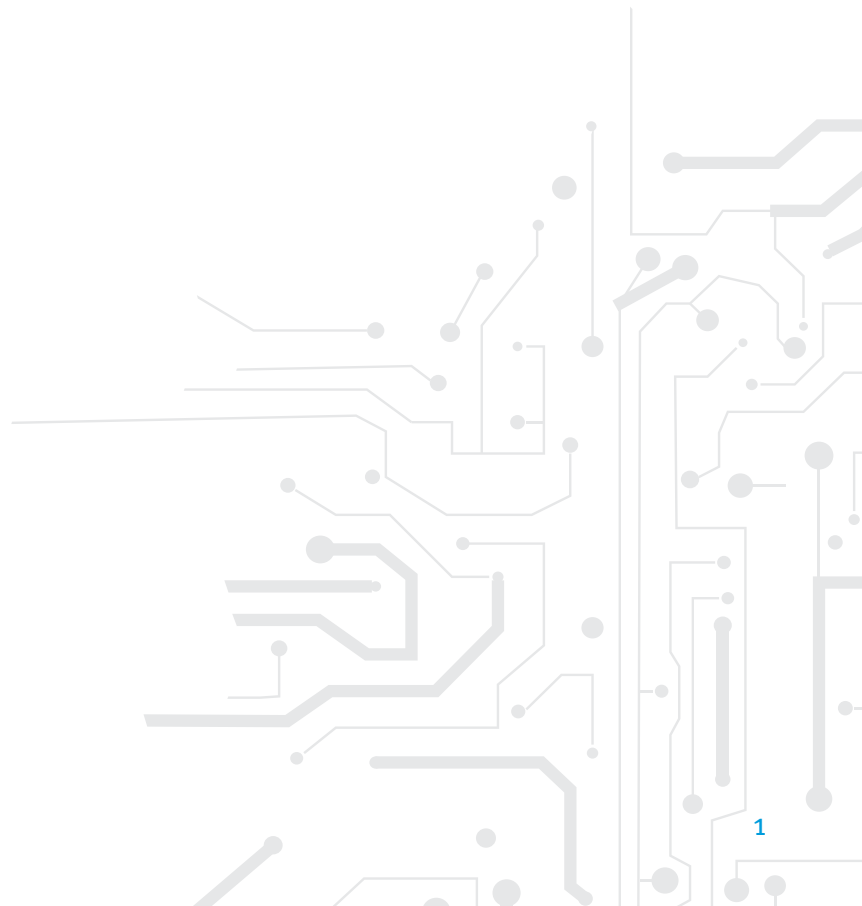
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**Industry 4.0 could contribute to finding new ways of dealing with major global challenges, such as climate change, lack of clean energy access, economic stagnation and reducing the digital divide**

However, understanding the potential opportunities and also challenges that Industry 4.0 may pose on countries with various levels of industrialization is necessary to outline the limits, barriers and risks it may pose to inclusive and sustainable industrial development. For instance, industrial production is undergoing a fundamental transformation. This process is informed by a vision where the physical world of industrial production merges with the digital world of information technology – in other words, the creation of a digitized and interconnected industrial production, also known as *cyber-physical systems*. These new state-of-the-art technologies offer increased deployment of renewable energy in manufacturing, reduced carbon emissions, optimized energy-use, heightened productivity and cost savings at an unprecedented scale.

**The SDGs are not to be approached in an isolated way. There are numerous interlinkages between them, which indicates that their implementation should mutually support each other**

One of the targets of SDG 9 specifically highlights the promotion of inclusive and sustainable industrial development and to raise the share of employment in manufacturing and the proportion of manufacturing value added to gross domestic product. Besides, SDG 9 sets increased access to information and communications technology (ICT) and affordable access to the Internet in least developed countries by 2020 as a specific target. Achieving these targets through the use of ICT and increased internet access could also help tackle SDG 7 and 13 in an integrated manner. This could trickle down and contribute significantly to sustainability and decarbonization in economic and industrial development.

**Numerous opportunities with high economic and energy saving potentials are associated with digital and interconnected manufacturing**

Among them is the ability to cost-effectively produce customized products due to the higher degree of flexibility. This means that the cost of producing one customized product is meant not to be significantly higher than mass production in the current manufacturing scenario. Another opportunity is to develop completely new business models based on the huge amount of data generated along the entire life cycle, starting from production, usage phase (including customer feedback), up to the end of life phase (e.g. recycling). Other than that, it is estimated that only 1% of existing data is analysed. Big Data could support sustainability, for instance by helping produce relevant statistics that enable better informed decision making as much on economic, environmental or societal issues.

**The sustainable energy transition and Industry 4.0 share important characteristics that can be interconnected to pursue a sustainable energy transition. Such integrated approaches could be guided by the SDGs, which provide important target setting for energy, climate action and beyond.**

For instance, both are highly influenced by technological innovation, dependent on the development of new suitable infrastructures and regulations as well as are potential enablers for new business models. These commonalities have not yet been translated into substantial policies to foster the transition to more sustainable energy systems and digital production at the same time and in an integrated manner. One concrete opportunity is that, industries account for a major share of electricity consumption – amounting in 2014 to 42.5 % worldwide (IEA 2016d) – and energy networks need to accommodate electricity demand from industrial consumers. This could be enough reason to think how the transition towards more sustainable energy systems and the digital transformation of industries could mutually benefit from each other.

**A comprehensive shift in manufacturing, production, energy efficiency, and renewable energy can be captured through two development pathways: Transforming and Leapfrogging.**

The transformation towards Industry 4.0 will involve retrofitting existing industrialized systems with Industry 4.0 technologies that could provide more sustainable solutions. Standardization, partnerships, and responsible policy design are all ways that lead up to maximizing the economic, social and environmental potentials of Industry 4.0. On the other hand, leapfrogging will provide developing countries with an opportunity to increase their share of industrialization without repeating the mistakes of traditional development pathways. Regions that are less developed can become candidates for the development of smart factories, decentralized micro-grids, etc. To support such a development, the challenges and opportunities associated with Industry 4.0 for countries with different stages of industrial development should be explored in more detail.

## Policy recommendations

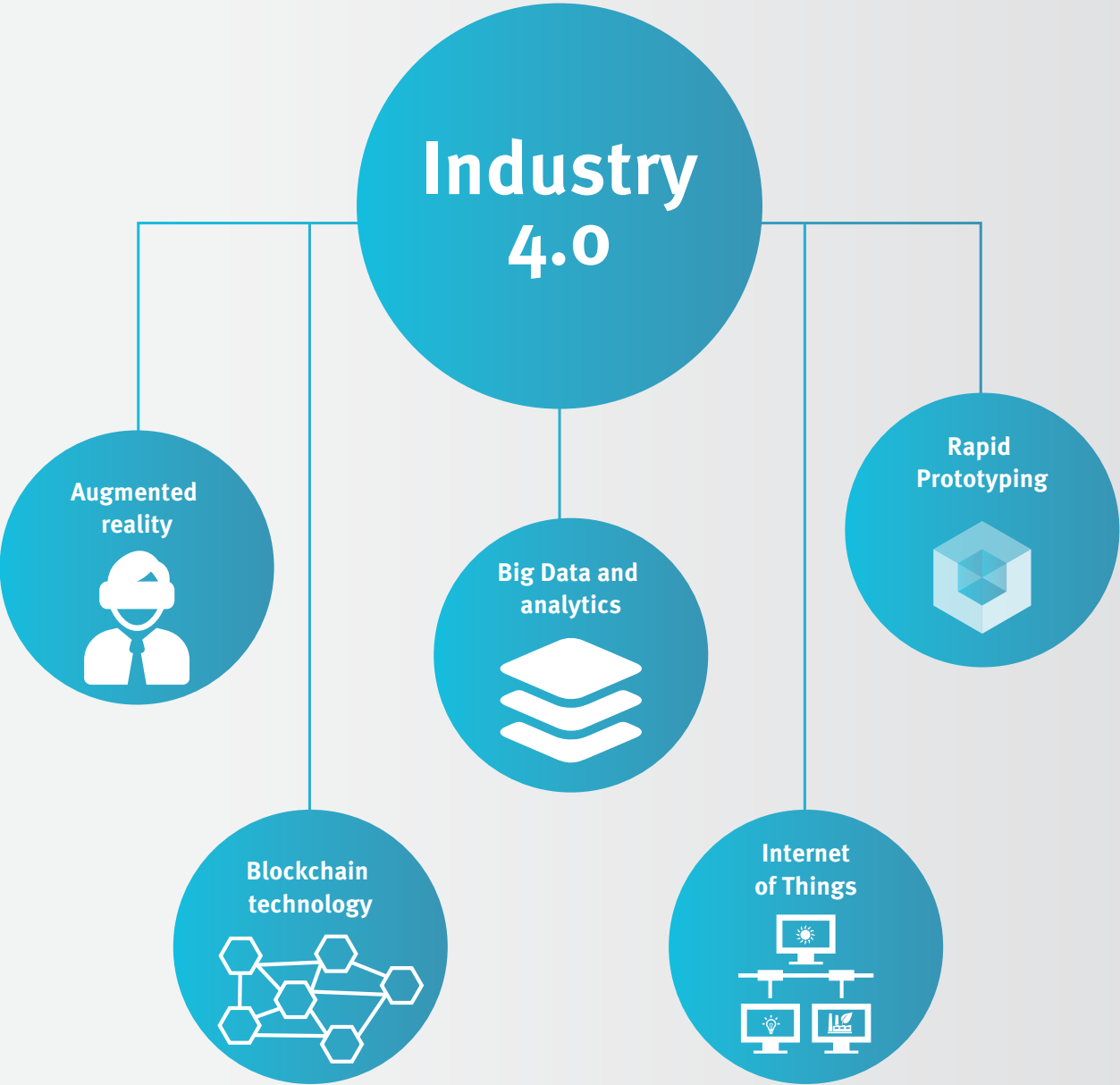
- **Maneuvering the innovation race:** The vast and increasing speed of technology development could lead to a first-mover advantage for pioneering countries or companies. This would give the few top runners large economic influence and – if regulations are weak – the power to lever out social and environmental standards. Countries should therefore not only be increasingly challenged to provide suitable framework conditions for innovation, but also to protect existing standards and to expand them to newly developing digital branches.
- **Increasing the agility of governments:** Digitization and Industry 4.0 are largely driven by actors from the economic sphere. Their pace often exceeds the speed at which policies and regulations can be formulated to govern digital and technology developments. In this way, policy making could become ineffective in impeding potential adverse effects, e.g. on privacy and data security, labor rights and safeguarding environment. Governments need to be more agile in adopting policies fast enough to ensure its citizens and countries will be protected from these adverse impacts.
- **Preventing the deepening of global inequalities:** Related to the previous point, inequalities between the economic development of industrialized, emerging economies and developing countries could further deepen if countries of the Global South cannot tap into digital development benefits. Developing and least developed countries should be enabled to use the possibilities of ICT and Industry 4.0 to achieve their development priorities. The creation of policies on the national, regional and global scales that ensure equal access and distribution of ICT and Industry 4.0 technologies is needed to prevent the deepening of global inequalities.

# What can UNIDO offer?

UNIDO has the capability and relevant portfolio to foster Industry 4.0 across all stages of industrial development. The mandate of UNIDO is to promote ISID that reinforces economic growth and diversification in a socially inclusive and environmentally sound manner.

- ✧ **UNIDO as a knowledge-sharing and project development platform:** UNIDO is capable of setting in motion the necessary programs. UNIDO's capacity to collect and analyze relevant data will provide major insights for facilitating Industry 4.0. Examples include evaluation of country preparedness and identification of resource gaps. Also, setting up knowledge and financial platforms can open the discussion between innovators, policy makers, and other key stakeholders to synchronize the trends of Industry 4.0 with the SDGs and ISID.
- ✧ **Retrofitting established industrial systems and leapfrogging technology waves with Industry 4.0:** Within this context, Industry 4.0 technologies could particularly enable **a)** developed countries to transform established industries and infrastructures in achieving ISID. This can be done by assisting in the coordination of financing mechanisms that will improve industrial energy efficiency in heavy industries. And **b)** developing countries to capitalize on the sustainable energy aspects of Industry 4.0 and move more rapidly towards ISID. UNIDO can play an important role in education and fostering entrepreneurship in Industry 4.0 technologies that will reduce the digital divide in ICT literacy, skills and infrastructure whilst promoting the setup of distributed, renewable energy systems next to fostering a technology start-up culture.
- ✧ **Partnerships with the private sector:** Innovative collaborations between the public and private sector can help assist developing countries to successfully implement Industry 4.0 technologies in their manufacturing processes. For instance, the private sector plays a large role in driving technology standards, financial solutions and targeted incentives to accelerate improvements. The public sector instead is responsible for creating sensible policies so that society and business flourish under this paradigm shift. Through extensive networks within both the public and private sectors, UNIDO can mediate win-win solutions in accordance with the SDGs and the Paris Agreement.

FIGURE 1 | **TECHNOLOGIES THAT REVOLUTIONIZE MANUFACTURING WITH A SUSTAINABLE ENERGY RELEVANCE**









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